

3.1 Design sustainability and production choices

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS design for disassembly • tolerance

Objective

Design sustainability and production choices. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

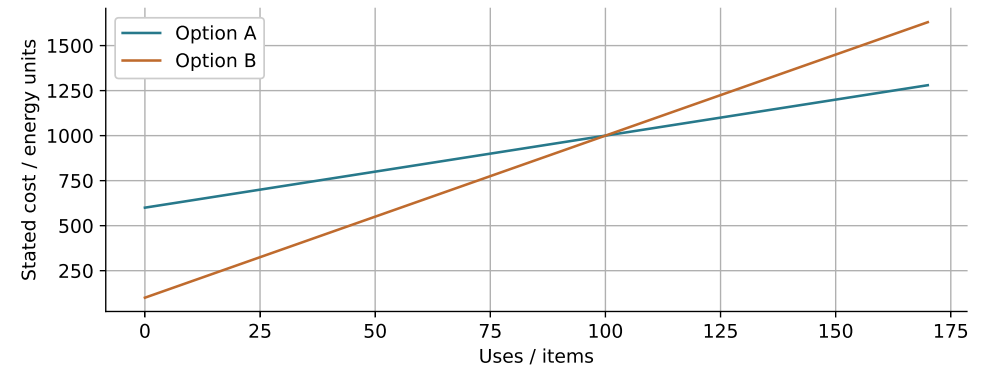
1 Key knowledge and worked examples

■ What would explain this observation?

- A repairable product may cost more initially but stay in service longer. A design decision needs evidence across manufacture, use and disposal.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Design for disassembly** supports separation of materials and replacement of parts. Manufacturing choices depend on production volume, **tolerances**, material properties and cost. Sustainability includes environmental and social effects.
- design for disassembly: Design supporting separation and replacement of parts; tolerance: An allowed dimensional variation.



■ Choose evidence that can test it

- Compare a common service over a stated lifetime. Separate fixed tooling cost from cost per item. Include repair, energy, transport and realistic end-of-life pathways rather than using a recycled label as the whole judgement.
- Create a bill of materials and an annotated assembly plan. Test whether a worn part can be replaced with normal tools. For HL project development, evaluate production feasibility and commercial assumptions against the applicable cohort guide.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: method A costs 600 fixed units plus 4 per item; method B costs 100 fixed units plus 9 per item. Equality: $600 + 4n = 100 + 9n$. Rearranging: $500 = 5n$, so $n = 100$ items. Other quality and sustainability criteria may change the choice.

Example:

Fixed costs differ by 400 units and unit costs differ by 5. Find cost break-even quantity. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- A cheaper process is not automatically preferable. Cost estimates need currency, quantity and assumptions, and prototypes do not prove mass-production consistency.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A recycled-content label establishes the entire product life-cycle impact. This claim is false: A cheaper process is not automatically preferable. Cost estimates need currency, quantity and assumptions, and prototypes do not prove mass-production consistency.

Key:

Design sustainability and production choices: Compare a common service over a stated lifetime. Separate fixed tooling cost from cost per item. Include repair, energy, transport and realistic end-of-life pathways rather than using a recycled label as the whole judgement.

2 Practice

2.1 Which supports repairability? Choose one answer.

- **A** Permanent bonding of every part
- **B** Accessible replaceable wear parts
- **C** Hiding all fasteners without a plan

[1]

2.2 Fixed costs differ by 400 units and unit costs differ by 5. Find cost break-even quantity. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A recycled-content label establishes the entire product life-cycle impact.

[2]

2.4 Design supporting separation and replacement of parts: write the technical term.

[1]

3 Exam-style questions

3.1 Methods cost $A=500+3n$ and $B=100+7n$. Find break-even and compare at 50 and 150 items. Why is cost alone insufficient?

[4]

Solutions

2.1 B Compare a common service over a stated lifetime. Separate fixed tooling cost from cost per item. Include repair, energy, transport and realistic end-of-life pathways rather than using a recycled label as the whole judgement.

2.2 $\text{quantity} = \frac{\text{fixed-cost difference}}{\text{unit-cost difference}} = 400/5 = 80 \text{ items}$.

2.3 False. A cheaper process is not automatically preferable. Cost estimates need currency, quantity and assumptions, and prototypes do not prove mass-production consistency.

2.4 design for disassembly. design for disassembly means Design supporting separation and replacement of parts.

3.1 Equality at 100. At 50: A650,B450; at 150: A950,B1150. Quality, capacity, waste, usability and lifecycle evidence may outweigh money cost.